

Assesment of the complications of Ultrasound and Fluoroscopy-Guided Placement of Totally implantable venous access ports

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ABSTRACT

Totally implantable venous access systems are widely used in oncology; however, their complications are extremely common which, sometimes, require device removal, thereby, leading to delayed chemotherapy and infusion therapies. In this study, we aimed to investigate the immediate, early, and late complications of venous port implantation in our oncology patients.

A total of 219 consecutive cancer patients (111 males, 108 females; mean age: 56.9 years; range: 1 to 81 years) were retrospectively analyzed between January 2013 and June 2014. A total of 220 ultrasound- and fluoroscopy-guided totally implantable venous port systems were implanted through the right or left internal jugular vein access.

The mean follow-up was 83.7 (range: 2 to 410) days. Overall complication rate was 8.6% (19/220). Eight devices in seven patients were removed due to complications. Two ports were removed in one patient. The complications which required port removal were compromised port-related bloodstream infection (n=5), central venous thrombosis (n=3), and catheter thrombosis (n=1). No major complication or no mortality associated with the port implantation was seen during follow-up. Totally seven immediate complications including local hematoma (n=2), catheter tip retraction (n=2), pain (n=1), catheter loop formation (n=1), catheter malposition (n=1), two early complications (n=2; 1 wound dehiscence, and 1 wound infection), and 10 late complications including catheter-related blood stream infection (n=5), central venous thrombosis (n=3), catheter thrombosis (n=1), and tunnel hematoma (n=1) occurred.

Low incidence of complications suggest ultrasound- and fluoroscopy-guided venous port implantation is a safe and reliable method for long-term venous access

Key Words: Totally implantable venous port, ultrasound guided, complications, fluoroscopy, ultrasound

Introduction

Totally implanted venous ports for administration of chemotherapy, parenteral nutrition, extended drug use, and blood sampling can be used in many patients with malignancies. Central venous ports are particularly useful for patients receiving chemotherapy to avoid venous toxicity (1).

Very early venous ports-related complications are defined as those which occur during or immediately after the procedure, including pneumothorax, hemothorax and pleural effusion, air embolism, arterial perforation, arrhythmia, pericardial tamponade, and nerve paralysis (2-6).

Early complications are those which occur during the first 24 hours after the procedure. Previously reported early complications include local pain, bleeding around the port area and hematoma, pocket hematoma, hemoptysis, disintegration of

the wound edges on skin, and disintegration of the septum from reservoir (2-7-9).

Late complications are those which occur later than the first 24 hours following the insertion of the port. Skin necrosis, skin infections, malposition, systemic infections-sepsis, fibrin sheath formation, superior vena cava erosion and perforation, chronic clavicular pain, extravasation and leakage from the catheter, vascular thrombosis, catheter migration, thrombotic occlusion of the intraluminal catheter, catheter fracture, catheter rupture, catheter entrapment, pinch-off syndrome, port rotation, and difficulties in the port entry are among the previously reported late complications(2-8-10-13).

In the present study, we aimed to evaluate the complications and management of complications which develop during insertion, use, and removal of the totally implanted venous access ports inserted to the patients with malignancies under the guidance of ultrasound and fluoroscopy.

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Fig. 1. Loop formation in the tunnel segment of the catheter and increased fat tissue of the patient

Materials and Methods

This retrospective study included a total of 219 patients in whom a port was implanted for chemotherapy between January 2013 and June 2014 at the interventional radiology unit of an university hospital. Data were obtained using the hospital database, interventional radiology registry, and radiology records. Data including age and sex of the patient, type of the primary tumor, time during which the catheter remained inserted, the jugular vein to which the catheter was inserted (right or left) and indications for insertion to left side, reason of port removal, if applicable, and the type and time (very early, early, late) of any complications were analyzed.

A written informed consent was obtained from each patient. The study protocol was approved by the local Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki

An ultrasound device with 7.5 MHz surface-linear probe (Mindray C3 Shenzhen/China) was used to visualize the jugular veins and to guide the procedure. During port catheter implantation procedure, images were obtained by an angiography device (Siemens Axiom Artis, Erlangen, Germany) with digital subtraction angiography capability (DSA) for scopic investigations and guidance.

All patients were inserted a titanium port reservoir with a silicon catheter (POLYSITE standard 4000 series (8F) silicone Perouse Medical Ivry, Le Temple, France for adult patients, POLYSITE Mini Adult 3000 series (7F) silicone) Perouse Medical Ivry, Le Temple, France for pediatric patients). In total, 220 ports were inserted to 219 (including eight pediatric) patients. One pediatric patient was inserted two ports, from separate veins (right internal jugular vein-left



Fig. 2. Significant retraction of catheter tip to superior and dislocation of the port cuff to caudal

internal jugular vein) in two sessions.

In total, the target vein was identified to be the right internal jugular and the left internal jugular vein in 217 and three procedures, respectively. Internal jugular vein was accessed in all patients through a low venous puncture using the Seldinger technique under the guidance of ultrasound. Localizations of the guidewire, introducer, and catheter were detected by fluoroscopy, and optimal extensions were, then, achieved. Port cuff was inserted to the fascia of the pectoralis muscle in all patients. The end tip of the catheter was terminated at the level of atriocaval junction.

All these patients were screened for such complications on every visit. According to the suspected complications, the patients were assessed by physical examination and specific radiological examinations (direct X-ray, computed tomography, B-mode ultrasound, and Doppler ultrasound) and imaging findings were recorded. A decision was given as to the complications required removal of the catheter and appropriate patient management was provided by consulting to the relevant clinics.

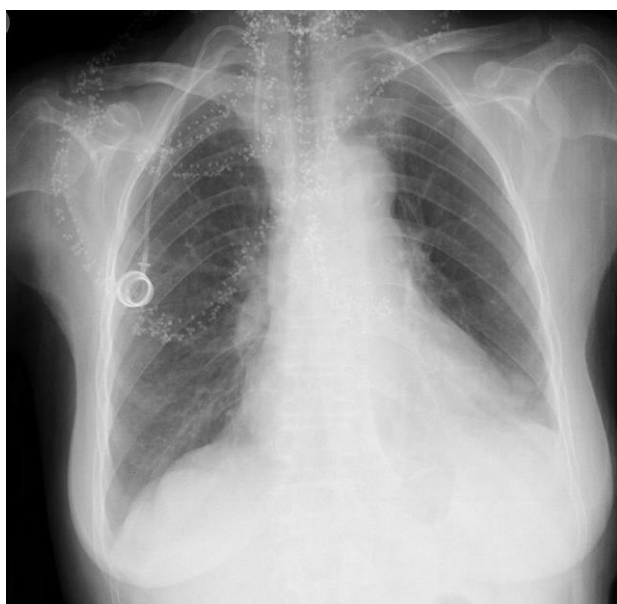
Results

In total, 220 ports were inserted to 219 (including eight pediatric) patients. One pediatric patient was inserted two ports, from separate veins (right internal jugular vein - left internal jugular vein) in two sessions.

Male/female ratio was 0.95 in the adult patient group and 3.0 in the pediatric group. In addition,

Table 1. Types and numbers of complications

Complications	Pediatric patients n:8	Adult patients n:211	Total n:219
Perioperative complication	n:0	n:7	n:7
Local hematoma	-	2	2
Pain (reflecting to shoulder)	-	1	1
Catheter end tip retraction	-	2	2
Catheter loop formation	-	1	1
Malposition (rotation of the catheter towards the subclavian vein)	-	1	1
Early complication	n:2	n:0	n:2
Wound disintegration	1	-	1
Skin infection	1	-	1
Late complication	n:8	n:2	n:10
Catheter related infection	5	-	5
Catheter thrombosis	1	-	1
Venous thrombosis	1	2	3
Hematoma (towards the skin)	1	-	1

**Fig. 3.** Significant-moderate retraction of catheter tip to superior**Fig. 4.** Rotation of the catheter tip to subclavian vein (marked angling and kinking can be noticed)

the ratio of pediatric to adult patients was 4%. The mean age of the study cohort was 56.92 ± 13.05 (range: 1 to 81) years. Total time of the ports remained inserted was 18,526 days in the entire study cohort with a mean time of 83.72 ± 94.45 (range: 2 to 410) days. Pediatric group included five cases (62.5%) with ALL and three cases (37.5%) with AML. The youngest patient who was inserted a port was a female infant with ALL aged 1 year, while the oldest patient was a male with colon cancer aged 81 years. All ports were inserted into the chest at the anterior of the fascia of the pectoralis major

muscle and the catheters were transferred to the entry of the right atrium through the internal jugular vein. The target vein was the left internal jugular vein in three patients ($n=3$, 1.3%). Two of these patients had right-sided internal jugular vein thrombosis, while the third patient underwent total mastectomy of the right breast. One of the patients with right internal jugular vein thrombosis was a pediatric patient (an ALL patient aged 17 years), and the other was a 54 years old patient with gastric cancer. Both of these patients previously experienced a right internal jugular vein thrombosis as a complication of the



Fig. 5. Subtotal thrombosed internal jugular vein (hematoma region associated with the thrombosed region and its localization close to the skin can be easily noticed by ultrasound)

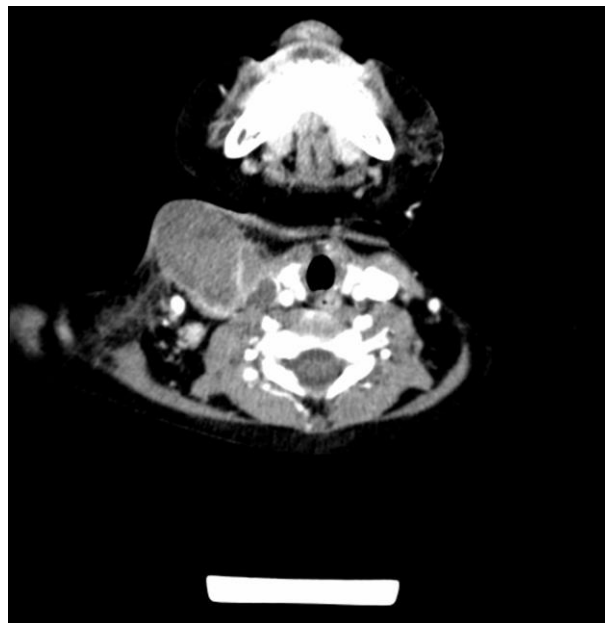


Fig. 6A. Subtotal thrombosed right internal jugular vein in contrast-enhanced thoracic computed tomography (lateral alignment of the lesion and mildly heterogeneous hyperdense structure can be noticed. Subtotal thrombosed internal jugular vein can be seen medial to the lesion)



Fig. 6B. A coronal reformatted contrast-enhanced neck computed tomography image (A region of hematoma neighboring subtotal thrombosed internal jugular vein segment can be seen at the right side of the neck. Total thrombosed right subclavian vein can also be noticed in more inferior)

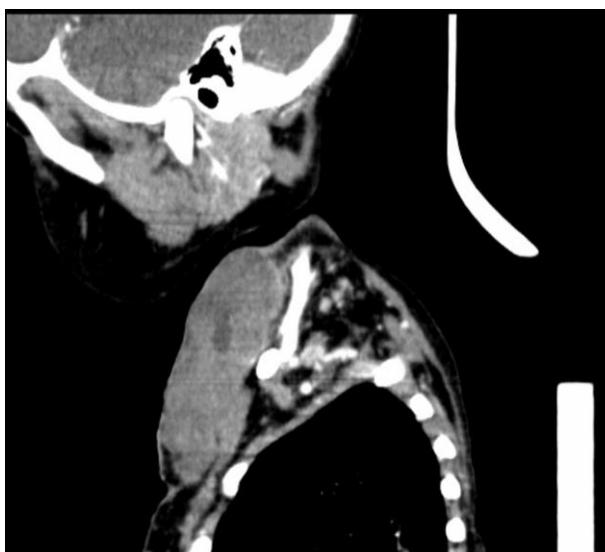


Fig. 6C. A sagittal reformatted contrast-enhanced neck computed tomography image (A region of hematoma can be seen at the right side of the neck).

right-sided port and their catheters were removed. No mortality or a major perioperative complication such as pneumothorax, hemothorax, air embolism, pericardial tamponade, or arrhythmia developed during the procedure.

In 12 port insertion procedures in 11 patients, seven very early (perioperative) (one catheter loop formation (Fig. 1), two hematomas, one pain reflecting to the shoulder, two up-shifting of the catheter tip (Fig. 2,3), one rotation of the catheter towards the subclavian vein (Fig. 4), two early (one wound disintegration, one skin infection), ten



Fig. 7. Total thrombosed right jugular vein

late (five infections, one catheter thrombosis, one hematoma towards the skin (Fig. 5,6A,6B,6C), and three internal jugular vein and/or subclavian vein thrombosis (Fig. 7) developed. A total of 19 complications were seen in 8.6% of the patients. The rate of very early complications was 3.2% (n=7), early complications was 0.9% (n=2), and late complications was 4.5% (n=10). In total, 11 of 19 complications developed in pediatric patients. Eight complications developed in eight adult patients, while 11 complications developed in five pediatric patients (four in two patients each, and one in the remaining three patients). Complications are shown in (Table 1). In total, 10 port removal procedures were carried out in nine patients. Of these, four were adult (in four patients, 40%) and five were pediatric cases (totally six patients, two procedures in one patient, 60%). Indications for the port removal was completion of therapy in one (n=1 adult patient, 10%), patient's refusal to receive therapy in one (n=1 adult patient, 10%), jugular vein and subclavian vein thrombosis in two (n=2 adult patients, 20%), catheter thrombosis in one (n=1 pediatric patient, 10%), and catheter-related

infection in five patients (totally five in n=4 pediatric patients, 50%).

Discussion

Central venous catheters are very useful in the management of various medical conditions requiring regular blood sampling, total parenteral nutrition, chemotherapy and prolonged antibiotic use, as they provide transient and long-term central venous access. In recent years, implementation of central venous access procedures has become a topic of interventional radiology rather than surgery and the use of imaging-guided methods have increased the success rate, while markedly reducing the rate of complications (2-14). Interventional radiologists also play a key role in the diagnosis and management of the complications of central venous access procedures, as well as the recovery of a malfunctioning central venous line (14).

In a study, Ignatov et al. (1) investigated a total number of 550 patients with breast and gynecological malignancies who were inserted a totally implanted venous port for 11 years. The authors found that the

complication rate increased, when the port was inserted to the left chest, to the subclavian vein, when the catheter ended at the peripheral of the superior vena cava, and when the body mass index of the patient was over 28 kg/m². In our patient group, three patients were inserted a port from the left side and none of these patients developed any complication. A loop formation was pointed out in the scopy images after the catheter insertion in one obese patient with a short neck (Fig. 1). However, the patient did not develop any complication during follow-up. Although these data are supported by the fact that the only markedly obese patient (body mass index: 34 kg/m²) in the present study developed a complication, the patient also had a short neck and apparent pericervical fat tissues. Thus, in addition to obesity, such a neck structure should be considered for an increased complication risk during the port insertion.

In their study including 98 patients with an implanted port, Lai et al. (15) defined catheter-associated candidemia as the growth of at least 15 colonies of *Candida* spp. per milliliter in the culture of a removed catheter tip and growth of the same *Candida* spp. in the catheter tip and in the blood. Their findings demonstrated that, independent of the other significant factors, candidemia was associated with poor clinical course. One pediatric patient in the present study developed a right-sided complication (*E. coli* growth in blood culture), after which, the port inserted to the left side was removed on the 54th day due to growth of *Candida* spp. in blood culture. The patient's overall status was poor and was being monitored in the intensive care unit. Growth of *Providencia alcalifaciens* in blood culture of a 10 years old male with acute lymphoblastic leukemia (ALL), *Burkholderia cepacia* in blood culture of a 15 years old male with acute myeloid leukemia (AML), *Escherichia coli* in blood culture of 17 years old male with ALL and *Enterococcus faecalis* in blood culture of a 2 years old male with AML were also detected. Also ports were removed in both these four patients and appropriate antimicrobial therapy was started. All infectious complications developed in the pediatric patients. Considering all pediatric patients had hematological malignancies, this ratio can be explained by immunosuppression (primary bone marrow suppression and drug-induced bone marrow suppression) and drug-resistant agents. None of the adult patients developed an infectious complication.

In a study performed by Dede et al. (9), among 1,418 procedures of port insertion through internal jugular vein performed between 2003 and 2007, 12 cases of port area necrosis and four cases of catheter thrombosis were reported. The final rate of complications was found to be 4.71% (67/1418). The study included a similar population compared to our

study, and used the same vein; however, we did not observe any port area necrosis in our study. This is possibly due to the shorter duration of follow-up compared to the aforementioned study (four years vs about 1.5 years). In addition, it is remarkable that the rate of internal jugular vein thrombosis in our patient series was markedly higher, compared to the aforementioned study (four internal jugular vein thrombosis/1,418 procedures vs three/220 procedures). All three patients who had developed internal jugular vein thrombosis in this study had concomitant right subclavian vein thrombosis (Fig. 7). The common characteristic of these three patients was that their jugular vein was controlled by ultrasound one month ago during their last visit. Two of these three patients were suffering from ipsilateral neck and arm pain and the last one had headache and swelling in his right upper extremity. The complaints of headache and ipsilateral neck pain should raise high suspicion for jugular vein thrombosis which may progress to subclavian vein thrombosis.

Gebauer et al. (16) reviewed a total of 228 patients who were inserted an implanted port under the guidance of ultrasound and fluoroscopy. They reported 23 complications including 12 port-related infections, five catheter thrombosis, three catheter migrations, two wound healing problems and one pain, and 12 of these complications required removal of the catheter. In that study, the total rate of complications was up to 10%, which is comparable to the complication rate recorded in this study (8.6%). In this study, a 32-year-old patient with testicle cancer developed a severe and very short-term pain reflecting to the right shoulder during blunt dissection, while the pocket was being opened for the port reservoir. A similar complication during the port insertion was not previously reported in the literature. Since dissection did not reach very deep intrathoracic structures and the patient did not develop concomitant respiratory failure, we believe that this was caused by a reflecting pain rather than a phrenic nerve injury. In addition, the patient did not develop any other complication during the remaining part of the procedure or during follow-up.

In addition, Hon et al. (17) investigated bleeding complications in 80 pediatric patients with acute leukemia who had a preoperative platelet count less than 50,000/mL (n=22, 10,000-49,000), which is considered as the safe threshold level, and more than 50,000/mL (n=58, 50,000-561,000). These two groups had normal and comparable preoperative prothrombin time (PT), partial thromboplastin time (PTT), and INR results. At the end of the study, although no bleeding complication developed in the group with low platelet counts, two patients (3.5%) with high platelet counts developed hematoma. As a

result, the authors concluded that preoperative thrombocytopenia was not associated with increased postoperative complications in children with acute leukemia who were inserted an implanted port. In our study, patients with a platelet count <30.000/mL and an INR >1.6 were excluded, and platelet count of all patients was over 50.000/mL during the procedure. On the other hand, a 2-year-old male patient with AML, who developed thrombosis of subclavian vein and had an hematoma towards the skin following the removal of the catheter, had a platelet count <30.000/mL at the time of the hematoma formation (24.000/mL)(Figure 5,6A,6B,6C). Therefore, based on our findings, we recommend that the patients with a platelet count <30.000/mL should be more carefully monitored particularly with respect to hematoma-related complications.

Teihgraber et al. (18) reported tip retraction in 30 out of 98 patients who were inserted a port (20 mild, nine moderate, and one severe retraction). Retractions <3 cm were considered as mild, between 3 and 6 as moderate, and >6 cm as severe. The authors reported a very high rate of catheter retraction compared to the previous studies, and the authors attributed this difference to the reservoir interval of the used port. In total, 24 of 30 retractions occurred in women and six occurred in men, and the predominance of female sex was explained by pulling-up of the catheter by the relatively larger breast tissue, particularly in the standing position. In the present study, the localization of port in the internal jugular vein was angiographically confirmed in two patients following a non-complicated port insertion. However, postoperative thoracic X-rays and images taken in the standing position showed catheter tip retraction in these two patients (Fig. 2,3). The common characteristic of these two patients were that they had breast tissue with inferior extension, and thus, in consistent with the aforementioned study, catheter retraction was attributed to pulling-down of the port reservoir and, thus, the catheter by the dense breast fat tissue.

Short follow-up duration of some patients is the major limitation of the study. Also relatively smaller number of pediatric patients does not allow a comparison between adult and pediatric patients.

In conclusion, use of fluoroscopy and ultrasound during the insertion and follow-up, provides benefits in the patients.

We declare that there are no conflicts of interest

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